International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2019): 7.583

Agricultural Residue Burning and its Effect on Environment

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Abstract: ***Agricultural residue burning of rice stalks and wheat straws are one of the main reasons for air pollution. This pollution has adverse effect on health of people as well as on climate. The study finds that growing better variety of rice helps in improving the financial status of farmers and thus they use the combine-harvester technology which in turn makes burning almost certain. Although a ban on burning residue was imposed . Then there is example of use of Happy Seeder machine which is said to have an impact on reduction of air pollution. This machine works by sowing seed in loose remains thus making the process of burning not necessary. Happy Seeder as compared to traditional forms of burning of agricultural residue turns out to be more efficient. There are other options or alternative uses of rice and wheat straws from which they can be re used and eliminate burning process.***

Keywords: Happy Seeder, Rice straws, Residue burning, Wheat straws

1. Introduction

Agricultural production plays a very important role in the economic growth of a country. As a result of increase in population around the world there is an increase in demand of food production due to which there is a higher production taking place around the world. As the agricultural activities are increasing there is tremendous increase in pollution caused by these activities such as burning of agricultural residue. Municipal board does not deal with the agricultural waste management system but it is to be managed by the owner of agricultural land. Lands which were used as a waste disposable land have now been converted into arable lands because of development in water management system. Due to all these activities there is a sudden increase in the problem of disposal of agricultural waste. As a result there is need to burn down the agricultural residue which in return have increased the rate of pollution and global warming.

India is the second largest country in which crops are grown throughout the year which as a result produces a huge amount of waste including crop residue when there is no proper management of waste and absence of dealing of waste in a sustainable manner. India produces approx. 500 million of waste annually which when burned produces a huge amount of air pollution in the form of emissions and dangerous gases that gets mixed in the air surrounding us. Burning of crop residue has become a major problem not only in India but to various countries around the world because of which not only health problems are increasing but also it has contributed immensely in the increase of global warming. Indian government has tried various steps including launching of special schemes to convert crop residue into some form of energy. However, in recent years from 2015 and beyond the problem of residue burning have risen alarmingly in Delhi and north eastern parts of India which creates a black soot in the air which is harmful for health and studies have shown that due to this type of weather there is an increase in health problems such as lungs infection, respiratory issues etc. Governments of India and other developing countries can benefit from the emerging connection ideas in environmental resource management. Nexus thinking promotes a higher level of integration and a higher level of stakeholder participation, transcending discipline boundaries, and providing a support platform for solving problems such as the burning of crop residues.

After rice harvesting farmers tend to burn stubble to get their fields ready for wheat cultivation. However Supreme Court has ordered Punjab and Haryana governments to allocate subsidies to farmers to address the problem by providing better incentives, better and affordable technologies and also a proper implementation of plan so that they could overcome the problem of Stubble Burning. Emissions from burning of crop residue contribute nearly half in formation of black carbon particulate matter that is soot in New Delhi during starting of winters. A study of Indian Institute of Technology have shown that pollution in Delhi happens in two phases in which one phase is crop residue burning.

2. Literature Review

1) **IOSR Journal of Mechanical and Civil Engineering (2013) Dapinder Deep Singh and Siby John** mentioned that many developing countries produce huge amount of agricultural residues. Major residues includes rice husks, coffee husks, jute sticks, mustard stalks. They give out huge amount of CO and NO during Burning . Briquettes proves out to be clean source of energy. It burns slowly giving out constant amount of heat and less amount of combustibles.
2) **Parmod Kumar and Laxmi Joshi (2013)** through a case study of Punjab pollution caused by agricultural waste says that crop burning residue cause severe pollution of both land and water. Straw carbon, nitrogen and sulphur are completely burnt in the air which results in the emission of smoke which if mixed with the elements present in air like methane, nitrogen oxide can cause severe atmospheric pollution. As a result of this a black soot is generated as a result of burning of these remains which causes skin diseases and lung infection etc. Thus an eco-friendly technology will be beneficial for farmers and state should provide a tool for improving soil health.
3) **Biomass burning- A study of Earth Systems and Environmental sciences (2018) Ishwar C Yadav** mentioned that biomass burning includes burning of forest, agricultural use for land cleaning process. Usually 90% burning is of man-made fires. These fires and

burning results in major gases like CO2, CO, NOx, CH4, VOCs. An estimate shows that 5%-10% of overall pollution is because of biomass burning. As burning happens it releases many years of stored CO2 into atmosphere in a very small time.

4) **The utilization if agricultural waste as one of the environmental issues in Egypt (2010) SD Abou Hussein , Omaima M Sawan and M Omaima** said that Agricultural waste in Egypt amounts to 30-35 million tons a year out of which only 7 million tons are used as a animal fees and 4 million tons are used as organic manure . As burning leads to the emission of poisonous gases therefore, utilization of agricultural residue is a friendly way and is very important. These can be done by - Producing compost by fermenting agricultural waste Animal feed production – Food production which can be done by growing mushroom on agricultural wastes such as rice straw as a substrate.

3. Objectives

1) To determine the reason of increasing amount of agricultural residue burning.
2) Understanding the damage caused to environment and health of people and also its contribution in global warming.
3) To study on other alternatives that are available to the problem of agricultural residue burning.

4. Scope of Study

This paper provides a study of problems caused by crop residue burning and its effect on the environment and also which measures can be taken to address the problem and what alternatives can be used by the farmers in order to reduce the rate of crop residue burning so that it's negative impact on the environment i.e. increase in pollution, health risks and contribution in Global Warming can be reduced.

5. Importance of agriculture

Agricultural productivity is very important for some reasons. Besides giving more food, it aims at improving farmer's livelihood and also improves the economic conditions. An expansion in an area's horticultural profitability infers an increasingly productive dispersion of rare assets. As ranchers embrace new methods and contrasts, the more gainful ranchers profit by an expansion in their government assistance while ranchers who are not beneficial enough will leave the market to look for progress somewhere else. Rise in agricultural activities not only eliminates poverty but also leads to agricultural growth in developing countries. Also there is a decrease in labour migration because when farms become more productive the money earned by the farmers also increases which as a result gives them a better working condition so they tend to migrate less.

Agricultural activities and production is very important to whole world. India is one of the top countries in which agriculture is done at a high pace but due to rapid increase in the population of country there seems to have a decreasing rate of land available for production activities, therefore many steps are being taken to consider the current situation and make more land available for production purpose. About four decades ago in North East India the major crop which was grown was wheat but with the passage of time rice and wheat became the main crops grown in combination. The combination of wheat and rice is majorly grown in areas of Punjab and Haryana and also in some parts of U.P.

As agriculture is the major source for providing us food and eatables, but it has some negative impacts on our environment also. Many production activities leads to emitting a great amount of pollution which has contributed a lot in the green house gases. For instance burning of crops residue gives out smoke which causes pollution and gives health risks to people. Also an increase in rate of production has tend farmers to use modern techniques so that production can be done at a very large scale. From which as a outcome it is seen that many natural sources are being vanished away. With the development in techniques of production there is a need to adopt sustainable development techniques so that the needs of future as well as present generation are being fulfilled. Sustainable way of production is cultivating in maintainable manners, which means meeting society's current food and material needs, without trading off the capacity for present or people in the future to address their issues. It tends to be founded on a comprehension of biological system administrations. There are numerous strategies to build the manageability of agribusiness. When creating horticulture inside economical food frameworks, it is critical to create adaptable business procedure and cultivating rehearses.

Farming has a gigantic ecological impression, assuming an outsized job in causing environmental change, water shortage, land corruption, deforestation and different procedures; it is at the same time causing natural changes and being affected by these progressions Developing practical food frameworks, adds to the maintainability of the human populace. For instance, perhaps the most ideal approaches to relieve environmental change is to make manageable food frameworks dependent on maintainable farming. Supportable agribusiness gives a potential answer for empower agrarian frameworks to take care of a developing populace inside the changing natural conditions. Practices that can cause long haul harm to soil incorporate exorbitant working of the dirt (prompting disintegration) and water system without satisfactory waste (prompting salinization). The most significant variables for a cultivating site are atmosphere, soil, supplements and water assets. Of the four, water and soil protection are the most agreeable to human intercession. At the point when ranchers develop and reap crops, they expel a few supplements from the dirt. Without recharging, land experiences supplement exhaustion and turns out to be either unusable or experiences decreased yields. Reasonable horticulture relies upon recharging the dirt while limiting the utilization or need of non-sustainable assets, for example, gaseous petrol or mineral metals.

Farming has an essential job in the development of any state. The essential area of an economy involves rural and different exercises and contributes a huge add up to the Gross Domestic Product (GDP). Agribusiness gives crude

materials to numerous enterprises which structure the foundation of the country. In particular, it encourages a country to endeavour by giving food and other agrarian items. India for model, which is essentially an agrarian nation, has a greater part of the working people occupied with farming exercises.

Pollution caused and its effect on health

Agricultural waste burning is one of the major sources of air pollution. Fumes generated by burning waste of farmlands contributes not only to air pollution but also to land pollution as well and on a large scale it contributes to greenhouse effect as well. Because of this the nitrogen content of soil is adversely affected. Straw, carbon, nitrogen and sulphur when burnt get completely lost in the air. This burning leads to emission of mixture of gases which when combined with the elements present in atmosphere can cause severe air and atmospheric pollution. The atmospheric pollution thus caused becomes the main reason for various diseases such as lungs infection, respiratory disorders etc. High level of air pollution can cause health problems such as:

1) Respiratory illness
2) Cardiovascular illness
3) Stress to Heart and lungs

When exposed to air pollution for long term can cause health problems such as:

1) Loss of capacity of lung function
2) Decreased life span
3) Aging of lungs
4) Increase in possibility of cancer
5) Development of diseases such as asthama, bronchitis etc.

Most effected people from air pollution are:

1) Senior citizens
2) Women on maternity period
3) Children who are below age of 14
4) Workers who works outside
5) Who exercises daily in outdoors
6) People who have heart diseases
7) People who have lung diseases
8) People suffering from Chronic Obstructive Pulmunory Disease

Impact of field burning in India

Increase in level of air pollution during the fall of winter is mainly because of the intensive post harvest burning of crop residue. Pollution levls from crop burning are so high they rival fossil fuel emissions during peak summer months. According to Health organizations New Delhi is one of the major cities with high rate of air pollution that is approx 14 times the recommended Government recommended levels. Because of air pollution nearly 2 million people are killed every year. Remaining of crops such as straws and husks etc. is burned in order to prepare field for next harvesting season. This burning gives out black carbon which is a result of incomplete combustion. These particles travel by means of air current from rural areas to New Delhi as far as from 125 miles.

Many farmers whose farms were on the borders of the states like Punjab and Haryana tends to clear their fields in order to make their land ready for production of wheat. This process was criticised because due to this activity there was a sudden increase in the air pollution which had majorly affected Delhi. Such resulting pollution became a record breaker in the books of levels of pollution. Because of such record breaking levels of pollution there was a situation of crisis which left Delhi into great trouble and there was an increase in health issues of natives living there and the burning of agricultural remains during the month of October-November was known to be the main culprit of this situation.

As straws and stalks burning in the states of Haryana and Punjab came out to be the main reason in the pollution of Delhi. The Government implemented the Great green wall of aravalli which was approximately 1700 km long and 5 km wide. Farmers of India tend to burn approximately 40 million agricultural waste during October and November. This extensive burning has resulted in formation of a “toxic cloud” which was also visible from the satellites. This toxic cloud is a heavy black soot or we can say cloud which lead to increase in pollution. As Delhi was unable to make proper plans and has not formulated stratigies to lower down the pollution, it was imposed with a fine of Rs. 2,00,000 by the National Green Tribunal.

After taking various of precautions by the Government the news came that amount of agricultural burning has reduced from past years in areas surrounding Delhi. But it was also seen that there was rise in amount of burning in other two states.

A scheme of odd and even was introduced in Delhi in 2016 for the movement of vehicles in which vehicles have odd number on their number plate was supposed to move on odd dates and even numbered vehicles was supposed to move on even dates. This scheme was launched by Delhi’s CM Arvind Kejriwal in order to control the level of pollution in the air and the results were shocking as pollution reduced relatively. Supreme Court’s authority which looks on the environment related matters that is the authorities of Environment pollution control and prevention board said that this step of odd even scheme was an effective step in order to control the levels of pollution.

Supreme Court order on Delhi’s pollution: In 2019 Supreme Court said that Government has failed in checking the pollution content in the air and asked the Government to present new reports on this issue and come back with the report on December 3 and asked the Government to make a research that whether hydrogen based fuels are more convenient than those of fossil based fuels if switched from one another. Use of Hydrogen based fuels is not very known in India but they are considered as zero emission generating means of fuels. Court also imposed injunction on crop residue burning but still the burning continued and it remains as a problem.

Increase in Delhi Air Pollution

There is a continuous increase in the pollution in India and area which is known for extensive increase in pollution is New Delhi. Because of this extensive increase in the pollution there is an increase in rate of cardio diseases and

respiratory and lungs dis-functioning. Also as a result of this air pollution there are many deaths reported of the issue of death of babies in their mother's womb. It was estimated that there were more than 3 million of cases of babies dying in their mother's womb. Pollution has also adversely contributed in lowering the life span of people as there is a rapid increase in various diseases.

Agricultural burning has contributed to about 47% in reaching the PM 2.5 level in Delhi which is said to be dangerous quality of air. During October and November as there is a rise in pollution it creates smog which becomes a difficulty for the people living there. Smog does not emerge from Delhi itself but it is a result of burning of crop waste done on the outskirts of the Delhi's area. Daily news coverage are there on this problem during that time. But over the time it is seen that now people are taking more precautions and they are much aware of the situation which is prevailing. But there is no scope or possibility of improvement unless and until Government takes major steps and bring out major policies to address this problem.

Supreme Court said that- Farmers working on their land for production cannot burn them in order to get rid of the waste. For their own better living they can't kill others as because of burning a huge amount of pollution has increased. Court also mentioned that residue burning is effecting not only people of Delhi but of other states too and because of this there is a huge adverse effect on their health as well. Court banned on residue burning and said who so ever will be found burning will be executed and punished as per the rules of law.

Alternate of burning: Happy Seeder

It was seen that Punjab was said to stop the agricultural burning which had a little contribution in controlling the levels of pollution thus they were said to use the combine harvester in order to eliminate the waste generating from rice crops or in other words rice straws. Still there was missing a promising alternative which can help effectively and efficiently in the residue eliminating process. In recent times when farmers do not have much labour available for working in their farms in such situation they tend to use the machine combine harvester. So in simple words we can say that farmers don't frequently use combine harvester to eliminate burning but instead they use combine harvester for the main purpose of sowing when they don't have enough workers for their farmlands which is a matter of worry. Machine combine harverster will be more helpful to farmers for the purpose of eliminating burning only when there is certain changes made in the technology which makes the machine to collect agricultural waste separately.

Other alternative was introduced that is the Happy Seeder Technology which can sow the wheat seeds in the loose residues of rice crops. It came out to be the better alternative for the purpose of eliminating crop waste by not burning and thus it contributed positively in reducing the pollution levels of the environment.

Further it was examined whether this machine or technology will come out as a promising option or not. For that various examinations were conducted and following outcomes were there.

6. Findings of Economical benefits of Technology

Yield Comparison

The Government of India said that wheat production is being effected by the use of Happy Seeder Innovation. As this technology is new, so for any new thing or technology to wins the heart of people takes time. It was observed that the owners of farmlands used this technology but they were not fully dependent on this technology which was evidiently visible from the fact that they used HST on half part of their lands and used primitive means of farming on their rest of the land. As there is mixed effects which makes this study a difficult one because no one has accepted this technology fully.

As wheat and rice are burned after they are harvested and when the harvesting is done the process of irrigation takes place. When the crops residues are burned they not only contributes in the pollution but increase in global warming also. It should be noted that these left overs can be used in increasing the nutritious content of the soil. Thus to overcome this situation the technology of happy seders were made to bring in picture. As today not every farmer is ready to accept the use of this technology. Government should bring schemes and provide incentives and subsidies so that more farmers tend to use this technology.

Farmers who used primitive form of agricultural techniques for eliminating the waste generated by rice straws and wheat straws came out to give out more pollution and thus also the nutrient content of their soil was deducted. However those who used HST not only got cost benefits but also yield benefits because with the help of this machine the rice straws are scattered lightly or lossely in which wheat seeds are ploughed. In this process also there are two phases firstly who uses machine and secondly who don't. As who uses HST for the purpose of planting seeds of wheat used less man power whereas on the other hand those who used labours for the purpose of planting seeds in the fields needed to employee a large amount of labours which would cost them a higher amount. Farmers can plant the seeds by both ways but its upto them which would be more benefitting to them. Also there is a huge role of crop residues in increasing the nutrient content of the soil. So the farmers who used crop residues on their firld and didn't burn them tend tohave better firlds than those who burn the residues. As researches were done on field of different location it was observed that by using this technology there was an increase in production of wheat by approximately 9.92% on field which used this form of technology for the purpose of sowing wheat. It came out as a method of suatainable manner of agriculture in which resources are not being harmed and also the environment surrounding us is not harmed and the agriculture is done efficiently. In other words we can say that achieving economical benefits without causing and adverse effect to environment. This type of agriculture is very important in developing countries.

Economic area

When we did a finding study on the cost benefits of the HST the first question came out that was whether this technology was a high cost option for traditional way of farming or to plow lands. In order to get an answer to this question it was needed to see people who had this technology. Few owners of farmlands owned this technology. Their study findings tell us that HST leaves the rice straws spread lightly or we can say it leaves out loose residue. Farmers said that in order to do this process that is to scatter the rice straws lightly or loosely they previously needed many workers to do this work which would amount more but when they used this technology they saw that this process of scattering the rice crop remains loosely was easily done by the HST. Whereas owners of farmlands who did not used this technology has to hire a labour for this purpose and give them wages accordingly. With HST the main expenses were employing ranch gear and all the diseal costs. It was suggested that owners of farmlands should use the method of leasing so that it can come out to be a great cost alternative as well.

Alternate uses of rice straw

There were many projects that were funded by the Rice Research Board authority to find out various ways in which rice straws can be used for economical purposes so that the process of rice straw burning can be skipped as a method of disposal. There are many ways in which rice straws can be used but not all came out to be fruitful. Alternative used includes:-

1) Livestock feed
2) Generating Energy
3) Paper production
4) Many industrial products
5) Fibreboard Making

Livestock Feed

Department of animal science conducted trials for determining the value of rice straws to be used in livestock animal feed. It was used for beef calves but studies shown that rice straws alone was not able to meet the expectations. They were required to be treated well before use. They were required to be treated with ammonia and sodium hydroxide. It was also found out that it is not very digestible in nature and also it has low levels of protein, calcium, phosphorus and other important minerals. It came out to be non-nutritive source of food.

Though it quality improved when it was treated with ammonia and sodium hydroxide which as a result improved the cellulose digestibility. After trials it was also seen that treated rice straws were consumed more rapidly as compared to untreated rice straws by sheep and cattle. After treatment it came out as a good supplier of carbohydrate and helps in gaining of weight in animals.

As a result, untreated straw came out to be not a good source of food and on the other hand chemically treated rice straws came out to be nutritious source of food for cattle and sheep.

Fibreboard Making

There were experiments that were conducted to see that if rice straws can be used in making fibreboards or not. For such experiment about 3000 pounds of rice straws were mixed with wood chips in order to produce fibreboards. This experiment was first conducted in Laborateries of Springfield, Ohio. Although in first place production with rice straw seemed difficult and firstly the production of fibreboard was done with a mixture of half percent of rice straws and half percent of hardwood chips. As a result the colour came out as dark. It was further seen that when rice straws were chopped into thin pieces and treated and cleaned and then further used in the process came out to be more helpful. The boards thus generated were given for dye. In this manner rice straws were used as a supplement in the process of making fibreboards.

Paper Production

China and Egypt were two countries which firstly used rice straws in the process of paper production. Paper can be made best from fibrous plants. Rice straw is an easily available material that can be used for paper making. It has a huge amount of fibre which comes out to be good for binding process and also it improves the transparency of paper and gives paper a smooth texture. Rice straw is bleached in order to make the paper but for the production of printing paper it is used in combination with wood pulp.

Pulp obtained from rice straws for the process of paper making is bleached in order to remove the colour present in the pulp up to certain amount. Process of bleaching is very important step in paper production. It is done in order to improve the quality of paper pulp by improving its brightness and purity and also aims at improving both chemical and physical characteristics of pulp.

Generation of Energy

Population now a days is booming like anything. As population is increasing day by day , there is modernization and urbanization also. As all these factors are increasing there is a need for modernization in technology also. For betterment of all these purposes there is extensive use of energy. Energy that we use from non- renewable sources like fuels etc are on the verge of getting extinct because of our extensive use of such sources. Today there is a need to find energy generating alternatives so that there could be less pressure on non-renewable sources. As agricultural activities are majorly happening in all countries around the globe, these activities gives out lot of wastes as well like rice straws left from rice crops and wheat straws left from wheat crops. We should find ways to utilize these sources for energy production. From studies it is seen that Rice straws can be used for the purpose of generating energy in the form of heat production. This heat energy can be utilized in homes for the purposes of boiling water and cooking and doing household chores. Government should provide incentives and proper planning schemes so that this type of energy can be generated from rice husks at a large scale and rice straws stoves should be encouraged.

Alternate use of wheat straws

1) As left over wheat straws cannot be used as a fodder they can be used in the production for bio friendly chemicals
2) Wheat straws can be used as bedding material.
3) Wheat straws can be used in soil in order to increase the nutrients of the soil.

4) Wheat straws are fermented, when they get fermented the sugar that is there in the wheat leftovers is used to get a chemical called ISO butane which is believed that it can take place of fuels that are generated from fossils, thus came out as a environmental friendly chemical.
5) It can produce and source of energy called bio fuel.

7. Conclusion

We found out that agricultural burning in farmlands is one of the main contributors of air pollution in whole world and in India as well especially in north east areas. In India farm fires basically appears in the month of April May and October November from mainly regions of Punjab and Haryana. Which when burned gives out smoke which when gets combines with the elements present in air tends to form black soot which causes health problems and environment problems.

We therefore conclude that rice and wheat residue is burned on high extent because it doesnot tends to provide any benefits to the farmers economically. The Happy Seeder technology was launched in order to help the farmers to scatter the wheat and rice husks loosely which otherwise would have cost the owners of the farms a huge amount of labour to accomplish such task. The findings of this report tells us that HST is a promising option for the owners of farm lands situated on the outer areas of Delhi. People who used this technology saved a lot as compared to people who still uses primitive form of farming. We also saw that the Happy Seeder technology was a cheaper option to conventional tillage for people who are not using this technology. Also alternative use of wheat husks and rice husks should be promoted and government should implement more schemes in order to suppress this problem and thus contributing in controlling air pollution.

This problem which has lead to various hazards is not being vanished completely but Government is taking this problem into consideration and trying to put forward more schemes and alternatives so that there can be a cure to this problem which can be economically feasible for farmers to adopt. Further researches are being done by various institutions to find a curb to this problem.

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